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National Technical Information Service

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Lost Island Lake, Clay and Palo Alto Counties, Iowa

Corvallis Environmental Research Lab, Oreg

Prepared for

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Aug 76

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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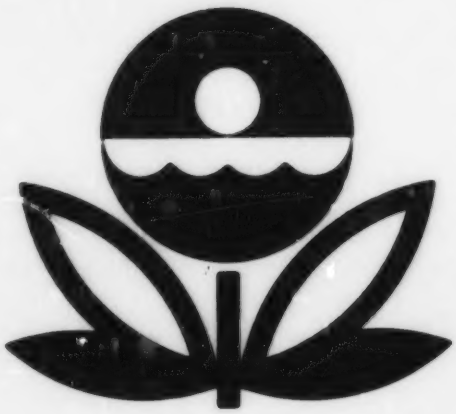

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

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REPORT

ON

LOST ISLAND LAKE

CLAY AND PALO ALTO COUNTIES

IOWA

EPA REGION VII

WORKING PAPER No. 499

WITH THE COOPERATION OF THE

IOWA DEPARTMENT OF ENVIRONMENTAL QUALITY

AND THE

IOWA NATIONAL GUARD

AUGUST, 1976

CONTENTS

	Page
Foreword	ii
List of Iowa Study Lakes	iv
Lake and Drainage Area Map	v
Sections	
I. Introduction	1
II. Conclusions	1
III. Lake and Drainage Basin Characteristics	3
IV. Lake Water Quality Summary	4
V. Literature Reviewed	8
VI. Appendices	9

FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Iowa Department of Environmental Quality for professional involvement, to the Iowa National Guard for conducting the tributary sampling phase of the Survey, and to those wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

The staff of the Water Quality Division of the Department of Environmental Quality provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

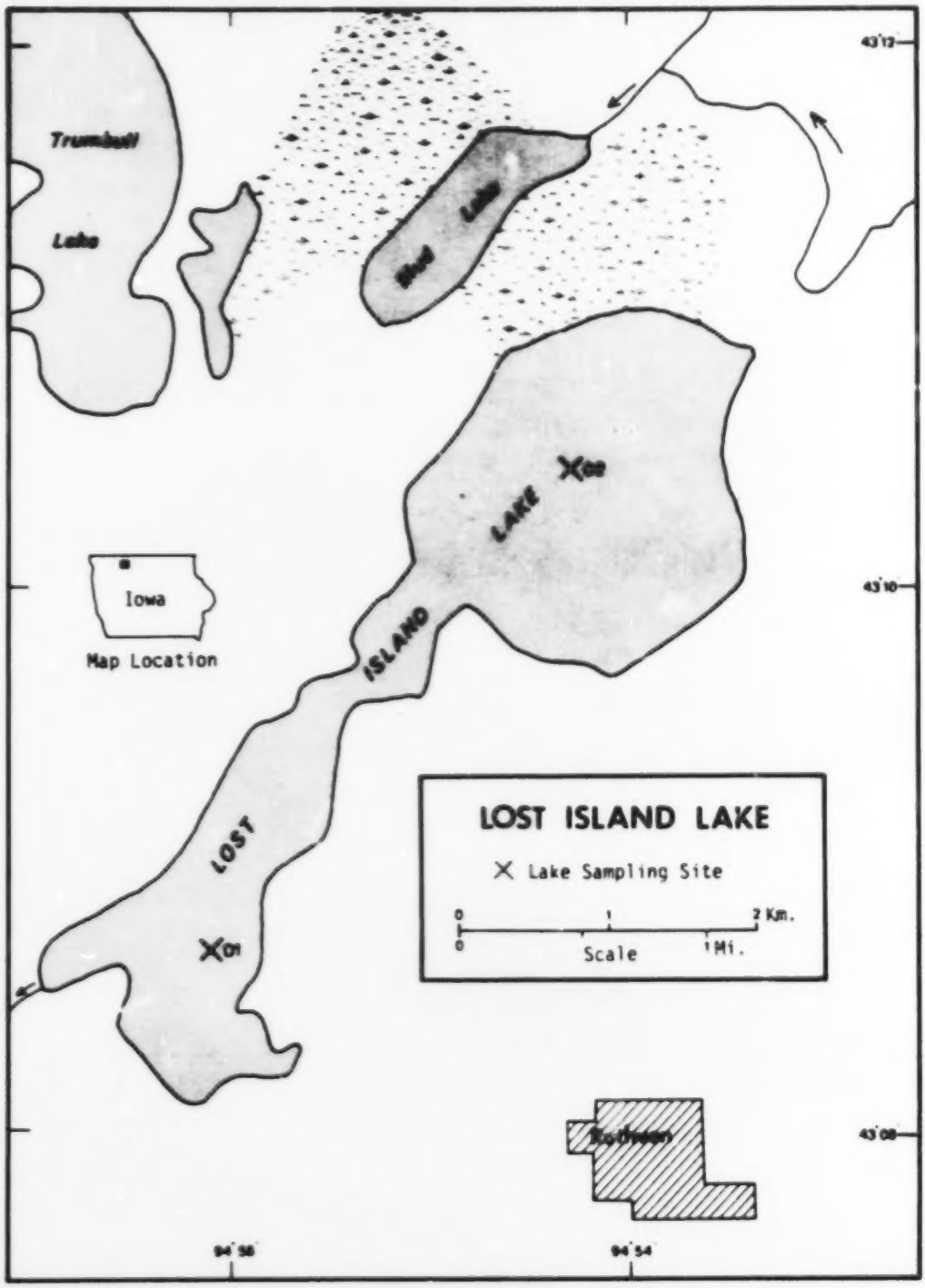
Major General Joseph G. May, the Adjutant General of Iowa, and Project Officer Colonel Cleadeth P. Woods, who directed the volunteer efforts of the Iowa National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF IOWA

LAKE NAME	COUNTY
Anquabi	Warren
Big Creek Reservoir	Polk
Black Hawk	Sac
Clear	Cerro Gordo
Darling	Washington
Lost Island	Clay, Palo Alto
MacBride	Johnson
Prairie Rose	Shelby
Rathbun Reservoir	Appanoose, Wayne
Red Rock Reservoir	Marion
Rock Creek	Jasper
Silver	Worth
Spirit	Dickinson
Viking	Montgomery
West Okoboji	Dickinson


Trumbull
Lake
Shell Lake
LAKE
ISLAND
LOST
Iowa
Map Location
LOST ISLAND LAKE
Lake Sampling Site
0
1
2 Km.
0
Scale
1 Mi.
43°12
43°10
43°08
94°58
94°54

LOST ISLAND LAKE

STORET NO. 1906

I. INTRODUCTION

Lost Island Lake was included in the National Eutrophication Survey as a water body of interest to the Iowa Department of Environmental Quality. Tributaries were not sampled, and this report relates only to the lake sampling data.

Lost Island Lake is the fifth largest natural lake in Iowa and is located on the broad flat uplands of the Des Moines lobe, a gently-sloping, poorly-drained drift plain. It is glacial in origin, is rather shallow, and has no major inlets. The lake is bounded in places by marshes and swamps. Moderate numbers of seasonal dwellings and a state park ring the north and east shores. Fish species present include walleyes, bullheads, and crappies (Anonymous, 1975).

II. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Lost Island Lake is eutrophic. It ranked sixth in overall trophic quality when the 15 Iowa lakes and reservoirs sampled in 1974 were compared using a combination of six lake parameters*. Eleven of the water bodies had less median total phosphorus, 12 had less median orthophosphorus

* See Appendix A.

and mean chlorophyll a, one had less median inorganic nitrogen, and one had greater mean Secchi disc transparency.

Survey limnologists noted abundant macrophytes at station 1 each sampling time and at station 2 in September. Algal blooms were observed at station 1 in September and at station 2 in July.

B. Rate-Limiting Nutrient:

The algal assay results are not considered representative of conditions in the lake at the time of sampling (04/22/74) due to nutrient changes in the sample during shipment. The lake data indicate phosphorus limitation in April and nitrogen limitation in September.

III. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 5.10 kilometers^2.
2. Mean depth: 3.0 meters.
3. Maximum depth: 4.3 meters.
4. Volume: 15.300 x 10^6 m^3.
5. Mean hydraulic retention time: unknown.

B. Precipitation*:

1. Year of sampling: 42.49 centimeters.
2. Mean annual: 70.92 centimeters.

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† Table of metric conversions--Appendix B.
†† Harrison, 1975.
* See Working Paper No. 175, "...Survey Methods, 1973-1976".

IV. LAKE WATER QUALITY SUMMARY

Lost Island Lake was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two or more depths at two stations on the lake (see map, page v). During each visit, a single depth-integrated (near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were near-surface at station 1 and 2.4 meters at station 2.

The lake sampling results are presented in full in Appendix C and are summarized in the following table (the July nutrient samples were not preserved properly and were not analyzed).

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR LOST ISLAND LAKE
STORET CODE 1906

PARAMETER	1ST SAMPLING (4/22/74) 2 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/ 9/74) 2 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (9/23/74) 2 SITES RANGE	MEAN	MEDIAN
TEMP (C)	9.0 - 10.2	9.9	10.2	24.6 - 24.8	24.7	24.7	11.9 - 14.5	13.9	14.5
DISS OXY (MG/L)	8.8 - 9.8	9.4	9.6	6.6 - 6.8	6.7	6.6	7.6 - 9.0	8.4	8.5
CNDCTVY (MCROMO)	303. - 369.	328.	303.	387. - 410.	402.	410.	263. - 291.	284.	291.
PH (STAND UNITS)	****** --------------------			8.6 - 9.0	8.8	8.7	8.7 - 8.9	8.8	8.7
TOT ALK (MG/L)	202. - 246.	217.	204.	****** --------------------			166. - 179.	173.	177
TOT P (MG/L)	0.097 - 0.212	0.137	0.102	****** --------------------			0.111 - 0.167	0.148	0.154
ORTHO P (MG/L)	0.006 - 0.014	0.011	0.012	****** --------------------			0.021 - 0.033	0.025	0.026
NO2+NO3 (MG/L)	0.060 - 0.220	0.163	0.210	****** --------------------			0.020 - 0.020	0.020	0.020
AMMONIA (MG/L)	0.190 - 0.320	0.273	0.310	****** --------------------			0.040 - 0.050	0.042	0.040
KJEL N (MG/L)	2.200 - 5.000	3.200	2.400	****** --------------------			2.300 - 2.900	2.600	2.700
INORG N (MG/L)	0.250 - 0.540	0.437	0.520	****** --------------------			0.060 - 0.070	0.062	0.060
TOTAL N (MG/L)	2.420 - 5.060	3.363	2.610	****** --------------------			2.320 - 2.920	2.660	2.720
CHLRPYL A (UG/L)	16.1 - 21.5	18.8	18.8	1.9 - 115.8	58.8	58.8	18.7 - 42.6	30.6	30.6
SECCHI (METERS)	0.5 - 1.0	0.7	0.7	0.3 - 9.2	4.8	4.8	0.4 - 0.6	0.5	0.5

B. Biological characteristics:

1. Phytoplankton* -

Sampling Date	Dominant Genera	Algal Units per ml
04/24/74	1. Flagellates	1,845
	2. Cryptomonas sp.	865
	3. Fragilaria sp.	807
	4. Ankistrodesmus sp.	692
	5. Dinobryo sp.	432
	Other genera	4,264
	Total	8,905
09/23/74	1. Aphanocapsa sp.	7,769
	2. Lyngbya sp.	7,684
	3. Melosira sp.	5,805
	4. Nitzschia sp.	5,122
	5. Merismopedia sp.	3,927
	Other genera	8,707
	Total	39,014

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
04/22/74	1	21.5
	2	16.1
07/09/74	1	1.9
	2	115.8
09/23/74	1	42.6
	2	18.7

C. Limiting Nutrient Study:

The algal assay results are not considered representative of conditions in the lake at the time the sample was taken (04/22/74) due to significant changes in nutrient concentrations in the samples during shipment from the field to the

* The July phytoplankton sample was lost in shipment.

laboratory. The lake data indicate the lake was phosphorus limited in April; i.e., the mean inorganic nitrogen to orthophosphorus ratio was 39 to 1. Nitrogen limitation is indicated in September (the mean inorganic nitrogen to orthophosphorus ratio was less than 3 to 1, and nitrogen limitation would be expected).

V. LITERATURE REVIEWED

Anonymous, 1975. Iowa fishing guide. IA Cons. Comm., Des Moines.

Harrison, Harry M., 1975. Personal communication (lake morphometry). IA Cons. Comm., Des Moines.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	1S-MIN OD	MEDIAN DISS ORTHO P
1901	LAKE ACQUABI	0.062	0.335	464.333	8.600	8.200	0.009
1902	BIG CREEK RESERVOIR	0.046	6.465	438.500	16.867	14.800	0.011
1903	BLACK HAWK LAKE	0.185	0.130	488.167	49.740	15.000	0.020
1904	CLEAR LAKE	0.059	0.070	465.125	17.400	8.600	0.010
1905	LAKE DAHLING	0.077	1.475	482.500	13.817	9.200	0.012
1906	LOST ISLAND LAKE	0.146	0.065	421.167	36.100	8.400	0.021
1907	LAKE MACBRIDE	0.061	2.035	458.444	17.067	15.000	0.010
1908	PRAIRIE ROSE LAKE	0.056	0.210	463.667	17.350	8.600	0.010
1909	RATHBUN RESERVOIR	0.071	1.170	475.889	12.039	14.000	0.006
1910	RED ROCK LAKE	0.180	1.880	473.400	14.730	14.000	0.104
1911	ROCK CREEK LAKE	0.065	1.400	480.500	18.367	8.400	0.007
1912	SILVER LAKE	0.193	0.565	482.667	95.300	10.000	0.034
1913	SPIRIT LAKE	0.041	0.090	422.667	12.622	9.000	0.007
1914	VIKING LAKE	0.075	0.130	459.000	26.033	14.200	0.017
1915	WEST LAKE OKOBOJI	0.046	0.060	380.444	7.722	15.000	0.017

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
1901	LAKE ACQUABI	57 (8)	50 (7)	43 (6)	93 (13)	100 (14)	79 (11)	422
1902	BIG CREEK RESERVOIR	89 (12)	0 (0)	79 (11)	57 (8)	21 (3)	50 (7)	296
1903	BLACK HAWK LAKE	7 (1)	68 (9)	0 (0)	7 (1)	7 (0)	21 (3)	110
1904	CLEAR LAKE	71 (10)	86 (12)	50 (7)	36 (5)	75 (10)	64 (8)	382
1905	LAKE OARLING	29 (4)	21 (3)	14 (2)	71 (10)	57 (8)	43 (6)	235
1906	LOST ISLAND LAKE	21 (3)	93 (13)	93 (13)	14 (2)	89 (12)	14 (2)	324
1907	LAKE MACBRIDE	64 (9)	7 (1)	71 (10)	50 (7)	7 (0)	64 (8)	263
1908	PRAIRIE ROSE LAKE	79 (11)	57 (8)	57 (8)	43 (6)	75 (10)	64 (8)	375
1909	RATHBUN RESERVOIR	43 (6)	36 (5)	29 (4)	86 (12)	39 (5)	86 (12)	319
1910	RED ROCK LAKE	14 (2)	14 (2)	36 (5)	64 (9)	39 (5)	0 (0)	167
1911	ROCK CREEK LAKE	50 (7)	29 (4)	21 (3)	29 (4)	89 (12)	96 (13)	314
1912	SILVER LAKE	0 (0)	43 (6)	7 (1)	0 (0)	50 (7)	7 (1)	107
1913	SPIRIT LAKE	100 (14)	79 (11)	86 (12)	79 (11)	64 (9)	96 (13)	504
1914	VIKING LAKE	36 (5)	68 (9)	64 (9)	21 (3)	29 (4)	32 (4)	250
1915	WEST LAKE OKOBOJI	89 (12)	100 (14)	100 (14)	100 (14)	7 (0)	32 (4)	428

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	1913	SPIRIT LAKE	504
2	1915	WEST LAKE OKOBOJI	428
3	1901	LAKE ACOUABI	422
4	1904	CLEAR LAKE	382
5	1908	PRAIRIE ROSE LAKE	375
6	1906	LOST ISLAND LAKE	324
7	1909	RATHBUN RESERVOIR	319
8	1911	ROCK CREEK LAKE	314
9	1902	BIG CREEK RESERVOIR	295
10	1907	LAKE MACBRIDE	263
11	1914	VIRING LAKE	250
12	1905	LAKE DARLING	235
13	1910	RED ROCK LAKE	167
14	1903	BLACK HAWK LAKE	110
15	1912	SILVER LAKE	107

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/12/23

190601
43 08 45.0 094 54 30.0
LOST ISLAND LAKE
19 IOWA

11EPALES 2111202
3 0002 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/22	12 45	0000	9.0	8.8	18	369		246	0.190	5.000	0.060	0.012
74/07/09	10 40	0000	24.6	6.6	364	387	9.00					
74/09/23	10 40	0000	11.9	9.0	17	263	8.95	166	0.040	2.900	0.020	0.021

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/22	12 45	0000	0.212	21.5	
74/07/09	10 40	0000		1.9	
74/09/23	10 40	0000	0.167	42.6	

STORET RETRIEVAL DATE 75/12/23

190602
43 10 30.0 094 56 00.0
LOST ISLAND LAKE
19 IOWA

11EPALES 2111202
3 0011 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/22	13 00	0000	10.2		40	303		204	0.310	2.400	0.210	0.006
	13 00	0002	10.2	9.6		303						
	13 00	0007	10.2	9.8		303		202	0.320	2.200	0.220	0.014
74/07/09	10 50	0000	24.8	6.6	12	410	8.70					
	10 50	0008	24.7	6.8		410	8.60					
74/09/23	10 00	0000	14.5	8.4	22	291	8.71	179	0.040	2.700	0.020K	0.026
	10 00	0002	14.5	8.6		291	8.75	177	0.040	2.300	0.020K	0.026
	10 00	0007	14.5	7.6		291	8.73	177	0.050	2.400	0.020K	0.033
	10 40	0000						166	0.040	2.900	0.020	0.021

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/22	13 00	0000	0.102	16.1	
	13 00	0007	0.097		
74/07/09	10 50	0000		115.8	
	10 50	0002			1.0
74/09/23	10 00	0000	0.111	18.7	
	10 00	0001			50.0
	10 00	0002	0.139		
	10 00	0004			1.0
	10 00	0007	0.154		
	10 40	0000	0.167		

K VALUE KNOWN TO BE
LESS THAN INDICATED